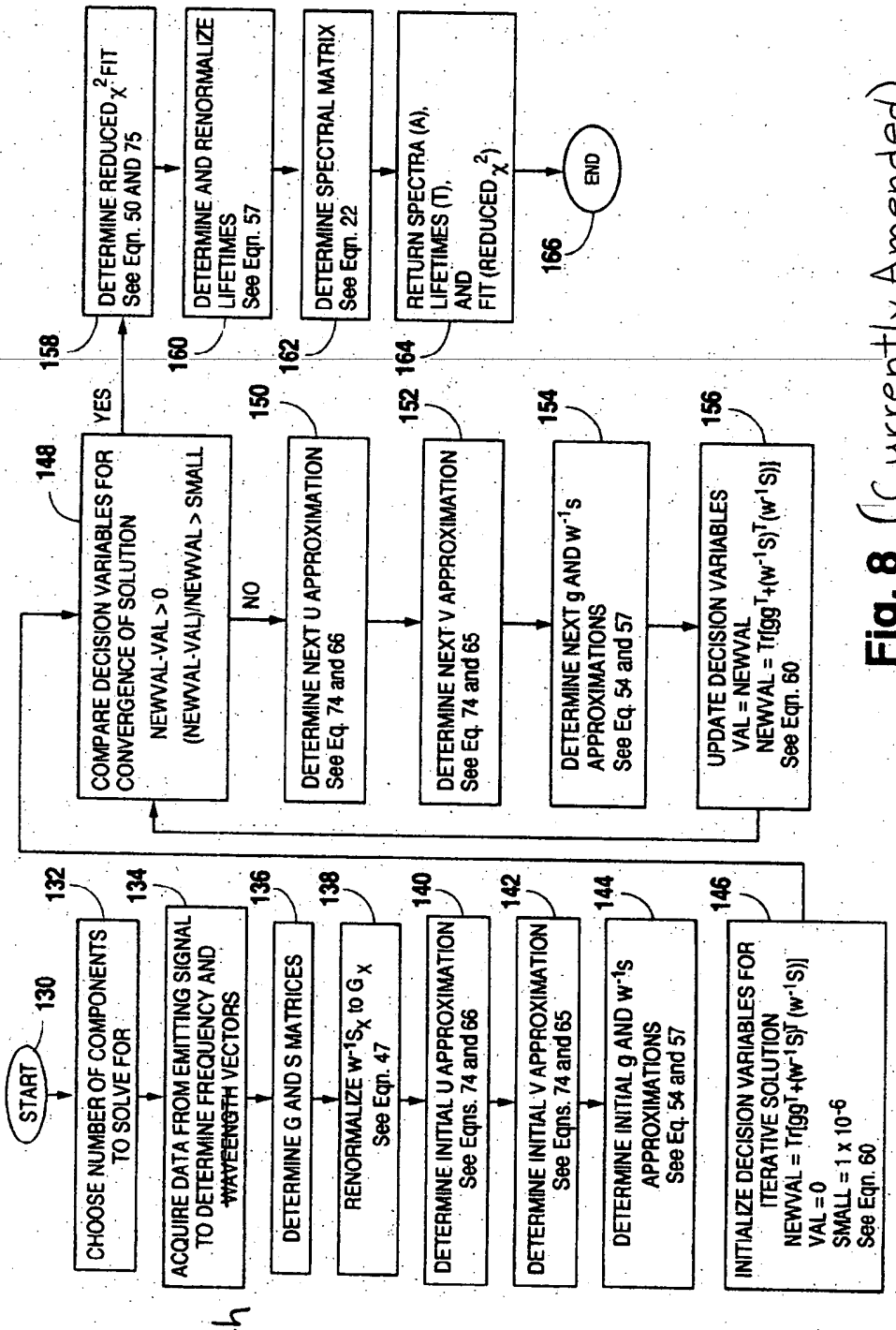

Fig. 8 (Currently Amended)

In The Specificati n

Applicant is amending the specification in this patent under 37 CFR 1.173(b) and 37 CFR 1.173(d). These changes include ministerial changes, grammatical changes, and mistakes made by the US PTO during the printing of the patent. Applicant is not adding new matter with these amendments.

Amend the specification with the selected replacement paragraphs on the following pages.

Paragraph at c. 2, l. 37-54.

In practice, we typically probe many different types of molecules at once with the excitation light pulse. FIG.2 illustrates the case where a single short excitation pulse of light 30 is absorbed by a sample of identical molecules all at once. The fluorescence decay curve 32 resulting from a typical fluorescence response of a sample of identical molecules is exponential in nature because not all of the identical molecules emits its fluorescence photon at precisely the same time. The exponential decay follows a mathematical function so that we can calculate the fluorescence lifetime, τ:

~~$I(t) = I_0 \cdot e^{(t-5)/\tau}$~~

$$I(t) = I_0 \bullet e^{-(t-t_0)/\tau}$$

where t_0 is the time of the excitation pulse, I_0 is the initial fluorescence and I(t) is the observed fluorescence intensity as a function of time.

Paragraph at c. 5, l. 30-43.

FIG.5 is a block diagram of the generator component 54 of the present invention for generating the excitation signal. The present invention uses heterodyning techniques to produce two sinusoidal RF signals, a driving/reference signal 90 and a mixing signal 92. The present invention modulates the frequency of the two signals from 10 MHz to 200 MHz. One skilled in the art will appreciate that the present invention could vary the signals over a much larger frequency range. The preferred embodiment of the present invention generates the two signals with a frequency difference of 10 kHz. Another embodiment of the present invention generates the two signals using an adjustable offset frequency where the offset frequency is set through to the present invention's control software.

Paragraph at c. 11, l. 26-44.

Another, equivalent, way of writing the eigenfunction equations proceeds from the observation that:

$$\mathbf{G} \cdot \mathbf{A}^{-1} = \mathbf{cc} \tag{23}$$

and

$$\mathbf{S} = \mathbf{cs} \cdot \mathbf{A} = \boldsymbol{w} \cdot \mathbf{cc} \cdot \mathbf{T} \cdot \mathbf{A} \tag{24}$$

so that

$$\boldsymbol{w}^{-1} \cdot \mathbf{S} \cdot \mathbf{A}^{-1} = \mathbf{cc} \cdot \mathbf{T} = \mathbf{G} \cdot \mathbf{A}^{-1} \cdot \mathbf{T} \tag{25}$$

or

~~$\mathbf{G}^{-1} \cdot \boldsymbol{w}^{-1} \mathbf{S} \cdot \mathbf{A}^{-1} = \mathbf{A}^{-1} \cdot \mathbf{T}$~~

$$\mathbf{G}^{-1} \cdot \boldsymbol{w}^{-1} \cdot \mathbf{S} \cdot \mathbf{A}^{-1} = \mathbf{A}^{-1} \cdot \mathbf{T} \tag{26}$$

Paragraph at c. 13, l. 10-40.

We may interpret the first of Eqns. (36) in terms of its column vectors as the representation of the r vectors of **cc** in the orthonormal basis of the r vectors of **U**:

$$\underline{c}_j = \sum_{i=1}^{r} \underline{U}_i P_{ij} \qquad (37)$$

where ~~c_j~~ $\underline{c}_j$ is the jth column of **cc**, ~~U_i~~ $\underline{U}_i$ is the ith column of **U** and P_{ij} is the corresponding element of $\mathbf{P_U}$. From this expression and the linear independence of the ~~c_j~~ $\underline{c}_j$ and ~~U_i~~ $\underline{U}_i$, we see that $\mathbf{P_U}$ is invertible. Linear independence of the ~~c_j~~ $\underline{c}_j$ requires that:

$$\sum_{j=1}^{r} \alpha_j \underline{c}_j = 0 \qquad \text{only if} \qquad \alpha_j = 0 \qquad \text{for all j=1,...,r.} \qquad (38)$$

From Eqn. (36), we see that Eqn. (37) implies:

$$\sum_{i,j=1}^{r} \underline{U}_i P_{ij} \alpha_j = 0 \ .$$

From the linear independence of the ~~U_i~~ $\underline{U}_i$, we must have

$$\sum_{j=1}^{r} P_{ij} \alpha_j = 0, \qquad \text{for all i = 1,...,r.} \qquad (39)$$

Paragraph at c. 14, l. 1-12.

A second method for solving Eqns. (30) is to use Eqn. (31) to write the pseudo inverse of **G**:

$$\mathbf{Gpi} = \mathbf{V} \cdot \mathbf{C}_1^{-1} \cdot \mathbf{U}^T \tag{43}$$

so that we have:

$$\mathbf{G} \cdot \mathbf{Gpi} = \mathbf{U} \cdot \mathbf{U}^T \quad \text{and} \quad \mathbf{Gpi} \cdot \mathbf{G} = \mathbf{V} \cdot \mathbf{V}^T,$$

where $\mathbf{U} \cdot \mathbf{U}^T$ is ~~and~~ an NxN matrix and $\mathbf{V} \cdot \mathbf{V}^T$ is an MxM matrix, and each of these matrices is of rank r.

Equation 63, c. 15, l. 64.

~~$\eta = Tr(\mathbf{M}_{\mathbf{V}} \cdot \mathbf{U} \cdot \mathbf{U}_{\mathbf{T}})$~~

$$\eta = Tr(\mathbf{M}_{\mathbf{V}} \cdot \mathbf{U} \cdot \mathbf{U}^{\mathbf{T}}) \qquad (63)$$

Paragraph at c. 17, l. 1-6.

As the frequencies in ***w*** are large, we renormalize $\|\boldsymbol{w}^{-1} \cdot \mathbf{Sx}\|$ to equal $\|\mathbf{Gx}\|$ so as to avoid skewing the results in favor of the **Gx** data 138. This amounts to a ~~rescaling~~ rescaling of the units for the frequencies and the lifetimes. This ~~rescaling~~ rescaling of units is compensated once the lifetimes are found, so they are expressed in seconds.

Paragraph at c. 18, l. 63 to c. 19, l. 16.

FIG.10 illustrates the present invention's ability to identify and discriminate between individual overlapping spectral components in a target mixture. The present invention allows for the extraction of both the individual fluorescence spectra and lifetimes from a target mixture of fluorophores. FIG.10 illustrates the present inventions ability to differentiate spectra using a three-dye mixture of OXAZINE™ 720, 725 and 750. OXAZINE is a trademark of Excition, Inc. We mixed the dyes at equal concentrations of 3.3 μM. We recorded the emission spectra for an excitation signal wavelength of 640 nm and the laser modulation frequency was swept (modulated) from 10 MHz to 140 MHz at 5 MHz increments. The present invention extracted fluorescence lifetimes of 3.705 nsec for Oxazine 720 (196 on FIG.10), 1.979 nsec for Oxazine 750 (198 on FIG.10), and 0.5588 nsec for Oxazine 725 (200 on FIG.10). The results from the present invention compared very well with the listed individual dye fluorescence lifetimes of 3.739 nsec for Oxazine 720, 2.014 nsec for Oxazine 750 and 0.9935 nsec for Oxazine 725. The individual spectra extracted for each dye from the mixture revealed spectral characteristics that matched with spectra obtained from the individual dyes.